volumes, e.g., measurements that have different requirements for pH or assay composition or otherwise negatively interfere with each other.

[0214] In an alternate embodiment employing a plurality of detection chambers, one or more of a plurality of detection chambers is used as control/calibration chamber for measuring assay control/calibration samples. In one such embodiment, a first and a second detection chamber are each configured to carry out a panel of one or more assays for one or more analytes. One detection chamber (the test chamber) is used to analyze a sample. The other detection chamber (the control chamber) is used to analyze a spiked sample having a predetermined additional amount of the one or more of the analytes of interest (this predetermined additional amount, preferably, being provided by passing the sample through a reagent pill zone comprising the additional amounts). The change in signal between the two chambers allows for the calculation of the responsivity of the signal to changes in analyte and can be used to calibrate the system and/or to determine if the cartridge is functioning properly. In another embodiment employing a control chamber, the control chamber is not used to analyze the sample or a derivative thereof, but is used to measure analyte in a separate control or calibrator matrix. The signal in the control chamber may be used for determining background signals (by using a matrix with no analyte), for calibrating the instrument (by using a calibrator matrix with a predetermined amount of analyte to determine calibration parameters) or to determine if the cartridge is functioning properly (by using a control matrix with a predetermined amount of analyte and determining if the signal falls within a predetermined acceptable range).

[0215] The cartridge fluidics may include bubble traps. The bubble trap is a chamber or conduit adapted for removing bubbles from fluid streams. Preferably, there is a bubble trap between the sample and detection chambers so that bubbles in the sample may be removed prior to introducing the sample into the detection chamber. **FIG. 31** shows a cross-sectional view of one exemplary embodiment and shows bubble trap chamber **3110** connected to inlet conduit **3140** and outlet conduit **3145** (the inlet and outlet conduits being, preferably, located near the bottom of chamber **3110**) and vent port **3150**. Liquid is introduced into chamber **3110** via inlet **3140**. Chamber **3110** is, preferably, wide enough so that bubbles in a liquid introduced to the chamber can rise to the top of the chamber and be expelled via vent port **3150**. Bubble-free liquid is then expelled via outlet **3145**. Optionally, outlet conduit **3145** is omitted; in this case a liquid is admitted via inlet conduit **3140**, bubbles are expelled via vent port **3150** and the liquid is then expelled back through inlet conduit **3140**. Optionally, an air-permeable but water-impermeable membrane (e.g., a membrane made from Gortex material) is placed between inlet **3140** and vent port **3150**. When a liquid passes through the conduit that contains bubbles or is present in a stream that is segmented by slugs of gas, the gas/bubbles will pass through the membrane and exit through vent port **3150** (preferably, the process is aided by applying suction at vent port **3150**) to ensure that liquid is not expelled via vent port **3150** (the optional membrane is shown as membrane **3190**).

[0216] The fluidic conduits can be located at any position within the cartridge and oriented at any angle. Advantageously, the fluidic channels are located, primarily, in planar networks, preferably located proximate to the outside surfaces (e.g., the top **901,902** or bottom **903** surfaces of the cartridge shown in **FIGS. 11***a-c*) to allow for a multi-layered cartridge design that uses, e.g., machined, die-cut, laser-cut and/or molded cartridge body components. Preferred conduit geometries include conduits with cross-sections that are circular, oval, square or rectangular in cross-section. The width is, preferably, similar to the height so as to minimize the surface area for a particular cross-sectional area. Width and height can vary widely from nm to cm ranges depending on the application, sample volume and cartridge design. Preferred ranges for the width and height are 0.05 to 10 mm, more preferably, 0.5 to 3 mm, most preferably 1 to 2 mm. Cartridges adapted to low volume samples such as blood from finger pricks may have small conduits, preferably having height/widths <1 mm, preferably between 0.4 to 1.0 mm.

[0217] The fluidic channels preferably make use of "z-transitions" that route the fluid flow path between planes. A conduit with such a z-transition may comprise first, second, and third conduit segments arranged in sequence, the first and third conduit segments being located in different planar fluidic networks and the second conduit segment connecting the two fluidic networks and arranged at an angle to the other two segments. By way of example, "z-transitions" (denoted in **FIG. 9** as capillary breaks) route the fluid flow/path, in the cartridge shown in **FIGS. 11***a-c*, from fluidic conduits near the upper surface **901,902** to fluid conduits near the bottom **903** surface and vice a versa. Z-transitions are advantageous in that they provide capillary breaks (as described below) and allow for more complicated fluidic networks than would be possible if the fluidic conduits were confined to one plane. Selective use/placement of capillary breaks, preferably z-transitions, may be used to control the passive flow of fluids and prevent mixing of fluid streams. Certain preferred embodiments of the invention employ "double z-transitions", that is conduits that comprise a first z-transition that directs fluid flow from a first planar network to a second planar network, a second z-transition that redirects fluid flow back to the first planar network and a connecting segment in the second planar network that connects the two z-transitions. Such a double z-transition may comprise first, second, third, fourth and fifth conduit segments arranged in series, the first and fifth segments located in a first planar fluidic network, the third segment located in a second planar fluidic network, the second and fourth segments located so as to direct flow between the two planar networks.

[0218] The fluidic network may be formed within the cartridge in a number of different ways, dependent, in part, upon the materials chosen for the cartridge. Any known fabrication method appropriate to the cartridge body material may be employed including, but not limited to, stereolithography, chemical/laser etching, integral molding, machining, lamination, etc. Such fabrication methods may be used alone or in combination. In certain embodiments of the invention, the cartridge comprises a cartridge body and one or more cover layers mated to surfaces of the cartridge body so as to define one or more fluidic networks (preferably, planar fluidic networks) therebetween. Similarly, z-transitions and/or ports can be selectively molded into, or machined out of, the cartridge body at predetermined locations to form the fluidic connections between the channels on the upper and lower surfaces.